

CONTROL OF A TRANSPORTER BASED ON ATTITUDE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. application Ser. No. 15/150,723 filed May 10, 2016, which is a divisional of U.S. application Ser. No. 14/589,116 filed Jan. 5, 2015, now U.S. Pat. No. 9,545,963, which is a continuation of U.S. application Ser. No. 13/908,587 filed Jun. 3, 2013, now U.S. Pat. No. 8,925,657, which is a continuation of U.S. application Ser. No. 11/691,903 filed Mar. 27, 2007, now U.S. Pat. No. 8,453,768, which is a continuation of U.S. application Ser. No. 10/617,598, filed Jul. 11, 2003, now U.S. Pat. No. 7,210,544, which claims priority from U.S. provisional patent application Ser. No. 60/395,589, filed Jul. 12, 2002, each of which is hereby incorporated by reference herein in its entirety.

TECHNICAL FIELD

[0002] The present invention pertains to transporters and methods for transporting a load, which may be a living subject, and more particularly to controlling motion of a transporter.

BACKGROUND ART

[0003] A wide range of vehicles having a motorized drive arrangement are known for conveying various subjects, either for purposive locomotion or for recreational purposes.

[0004] The means used to command the motorized drive arrangement of these vehicles varies greatly. For example, an operator may manipulate an accelerator pedal to control forward motion of an automobile, while steering is typically performed using a steering wheel. Or the motion of a sporting vehicle may be controlled by rocking a foot board upon which a user is balanced towards the front or rear to mechanically move a throttle cable, as described in U.S. Pat. No. 4,790,548 (Francken). Based on the operator's physical attributes for example, or the transporter's intended functionality, alternative methods for controlling motion of a transporter may be desirable.

SUMMARY OF THE INVENTION

[0005] In a first embodiment of the invention there is provided a transporter for transporting a load over a surface. The transporter includes a support platform for supporting the load. The support platform is characterized by a fore-aft axis, a lateral axis, and an orientation with respect to the surface, the orientation referred to as an attitude. At least one ground-contacting element, which is driven by a motorized drive arrangement, is coupled to the support platform in such a manner that the attitude of the support platform is capable of variation. A sensor module generates a signal characterizing the attitude of the support platform. Based on the attitude, a controller commands the motorized drive arrangement.

[0006] In accordance with related embodiments of the invention, one or more ground-contacting elements may be flexibly coupled to the support platform in such a manner that the attitude of the support platform is capable of variation based on a position of a center of mass of the load relative to the at least one ground-contacting element. The sensor module may include at least one distance sensor for

measuring a distance characteristic of the attitude of the platform. The distance sensor may be selected from the group of distance sensors consisting of an ultrasonic distance sensor, an acoustic distance sensor, a radar distance sensor, optical distance sensor, and a contact sensor, such as a whisker(s). The at least one distance sensor may sense the distance between a fiducial point on the platform and a position on the surface disposed at a specified angle with respect to the support platform. In other embodiments, the transporter may include a first component that remains in a substantially fixed vertical position relative to the surface, wherein the at least one distance sensor senses the distance between a fiducial point on the platform and the first component. One or more ground contacting elements may include a wheel having an axle, and the first component is fixed relative to the axle. Alternatively, and not meant to be limiting, one or more ground contacting elements may include a wheel supported by a frame, and the first component is fixed relative to the frame.

[0007] In accordance with other related embodiments of the invention, the attitude of the support platform is capable of variation based at least on a signal generated by a remote control device. The transporter may include a powered strut coupled to the platform, the powered strut capable of varying the attitude of the support platform based at least on the signal generated by the remote control device. The transporter may further include a user interface, wherein the attitude of the support platform is capable of variation based on a signal generated by the user interface. The controller may command motion of the transporter in the fore-aft plane and/or the lateral plane.

[0008] In accordance with another embodiment of the invention, a method for controlling a transporter having a support platform for supporting a load is presented. The support platform is characterized by an attitude with respect to the surface. The transporter includes at least one ground contacting elements flexibly coupled to the support platform in such a manner that the attitude of the platform is capable of variation. The transporter also includes a motorized drive arrangement for driving the at least one ground contacting elements. The method includes generating a signal characterizing an attitude of the support platform. The motorized drive arrangement is commanded based at least on the attitude.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The foregoing features of the invention will be more readily understood by reference to the following detailed description, taken with reference to the accompanying drawings, in which:

[0010] FIG. 1 depicts one embodiment of a human transporter, lacking a distinct user input device, to which the present invention may advantageously be applied;

[0011] FIG. 2 is a side view of a transporter, in accordance with one embodiment of the invention;

[0012] FIG. 3 is an expanded side view of a transporter, in accordance with one embodiment of the invention;

[0013] FIG. 4 is a side view of a transporter, in accordance with one embodiment of the invention; and

[0014] FIG. 5 is a block diagram of a controller of a transporter, in accordance with one embodiment of the invention.